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# Cost Accounting in the Manufacture of Iron and Steel Sheets

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## COST ACCOUNTING IN THE MANUFACTURE OF IRON AND STEEL SHEETS

Cost accounting as applied to the iron and steel industry has a great many ramifications, though possibly not more than any other manufacturing business, if control of costs is to result. This article is a comprehensive outline, we believe, of the cost accounting procedure in the manufacture of iron and steel sheets.

### Control of Expenditures

One of the most important features of a good cost system is the control of the expenditures which is made possible by laying out the Card of Accounts in complete detail *in natural control units*. These units are further subdivided in the detail necessary to control major operations within a department and also considering the fact that costs are wanted on various pieces of equipment over extended periods.

If the control is divided within a department two or more sections, or subdepartments, are made. For instance, all repairs and maintenance are under the control of the Superintendent of Maintenance, who is responsible for keeping the plant in repair and operation. As all departments and production centers have repair and maintenance charges such departments or centers are in two sections: 1. Those under the control of the Maintenance Superintendent, and 2, Those strictly under the control of the department head himself. The accounts, of course, follow one another on the Card of Accounts and are connected to a total for the department on the cost sheets.

This practice places a definite responsibility on a particular superintendent or foreman and enables expenditures to be controlled.

### Mechanical Work Orders

All mechanical charges are made up on mechanical work order cost sheets, carried separately under what is called the "Mechanical Control Account" on the general ledger. The cost department, of course, carries all detail connected therewith. The detail may be divided as follows:

1. Sub-work orders, in turn charged to
2. Card of Account (Manufacturing Account) monthly standing work orders.
3. Card of Account (Manufacturing Account) individual work orders.
4. Special Repair work orders.

5. General Ledger Accounts work orders.
6. Outside Parties work orders.
7. Employees work orders.
8. Construction Orders work orders.
9. Spare Orders work orders.
10. Store Stock work orders.
11. Real Estate work orders.

This control is closed out monthly and never carries any balance into the next month. Referring to the above orders in their numerical sequence they are closed out at the end of the month as follows:

2. To Card of Account (Manufacturing Account) cost sheets.
3. To Card of Account (Manufacturing Account) cost sheets.
4. To Card of Account cost sheets and other General Ledger accounts through the medium of a summarized "Report of Special Repair Orders." (Copies of this report are sent to all executives interested.)
5. To General Ledger miscellaneous accounts.
6. To Cost of Work for Outside Parties-in-process. When the order is completed the Cost Department vouchers against Miscellaneous Cost of Sales (Outside Parties).
7. To Employee's Ledger. (Deducted from their pay.)
8. To Construction Orders-in-process through a special "Report of Construction Order Expenditures for the month." (Copies of this report are sent to all executives interested.) When the Construction Order is completed it is vouchered to the various Fixed Asset accounts concerned.
9. To Spares Orders-in-process. As completed they are vouchered by the Cost Department to Stores Inventory.
10. Store Stock work orders. These are handled the same as item No. 9.
11. To General Ledger Other Income Account. (Real Estate Expense.)

A summarized "Monthly Report of Mechanical Expenditures" covering all the above is made out, copies going to various executives interested.

As the work order expenditures in a steel plant are very heavy full control of them is secured as follows:

(a) When the work order is made out a copy of it is immediately sent to the superintendent being charged notifying him of that fact. It is remarkable what errors in wrong and final charges are corrected and more remarkable what unnecessary expenditures are stopped before they are started through, due to this simple expedient.

(b) When the order is completed a copy showing cost of labor, material, overhead and total is immediately sent to
1 Superintendent of Maintenance.
2 Shop Foreman who issued order.
3 Superintendent of Department being charged.
Here is a control in the natural unit—a work order—in which the work was done.

(c) The Cost Department detail copy of the work order is finally filed away in Card of Account order, subfiled by work order number for instant reference in case any item on the regular cost sheets is questioned.

## Collecting Expenses

All Card of Account items are coded by numbers and a sorting and tabulating system is used for the collection of all expenses.

An example of coding, which applies through all items in the Card of Accounts, is as follows:

4150-76274

::: Signifies Distribution Class

: : :: " Method of Payment
: : : " Cost Sheet Class
: : " Item No. on Card of Accounts
: " Department Number

## Cost Sheet Class

The items will appear on the cost sheets according to this class, examples of which are "Non-Productive Labor," "Repair Labor," "Repair Material," etc. If it is desired to make further subdivisions and show a specific item then the sorting and tabulating is further carried from the Cost Sheet Class to the Item No. of the Card of Accounts.

## Method of Payment

The method of payment is either a fixed charge per month, or per day, per hour, per ton, etc. Idle time expense is determined by sorting for fixed charges in each department.

## Distribution Classes

Distribution classes are the groups into which the expenses of each department are sorted to be distributed to accounts or product participating. Examples are: charge tonnage; production tonnage; number of batches or heats, etc.; actual equipment hours; standard equipment hours, and square feet, etc.

Each department carries its own distribution classes. In all distributions an attempt is made to have them *natural* or according to the way they are used, for instance, buildings on a square foot basis, electric power on a K.W. hour basis, oil spread on the surface of a sheet on a square foot basis, etc. Unless this general plan is followed the costs are hardly worth the paper on which they are written. While there is some opposition to this plan, nevertheless, facts are facts—and costs *should* be facts. Any arbitrary way of distribution other than the natural way is *not* a fact. It is admitted, however, that where items are small and unimportant too much continuous time and expense should not be wasted going into ultra-refinements. All cost keeping should be based on common sense. We must not fool ourselves in our anxiety to get extreme simplicity.

## Collecting Labor

Labor is collected in one of four ways: 1, Departmental Daily Force Reports; 2, Job Service Cards; 3, Assignment Job Service Cards; 4, Gang Job Service Cards.

### 1. *Departmental Daily Force Reports*

Departmental Daily Force Reports are used for daily jobs that do not change and that are not chargeable to more than one Card of Account item. From these a tabulating card is punched by the timekeeping department and sent to the cost department.

### 2, 3, and 4. *Service Cards*

The three service cards mentioned above are used where the work is likely to be on any number of jobs during the day or where the work is entirely done on orders. They are practically one and the same thing, the Assignment card being used mostly by a centralized labor department for assigning men to various other departments. This is due to the necessity of keeping a labor supply on hand all the time. The Gang Service card is used where two or more men are working on the same order or Card of Account item.

These service cards are used for scheduling and are made out in triplicate, two carbon copies folding over one tabulating card copy. This card is consequently a dual one, the information being written thereon and the card punched from this writing.

As soon as the cards are rated and extended by the timekeeping department they send one of the carbon copies to the department superintendent being charged. One is returned to the department which issued it and the tabulating card copy is sent to the cost department.

Daily balances of the payroll are made. All pay ends on Saturday night for the week and the payments for the week are made the following Tuesday to Friday inclusive. All payroll cards are in the hands of the cost department by the third of the month following, as are also all material requisition cards.

## Collecting Material

Material requisitions are made out in three copies, exactly as the labor service cards above and sent to the same persons. Due to a local condition of machines the cost department in this case punches the information on the tabulating card copy.

## Departmental (Manufacturing Account) Cost Sheets

Departmental cost sheets are made out monthly from all the expense tabulating cards originally prepared for each and every department according to the Card of Account Department number,

two copies being ultimately typed—one for the General Manager and the other for the Treasurer or Works Manager. The latter copy eventually reaches the Superintendent or Head of the department interested. The main divisions of these accounts are:

1. *General Overhead*
   - Administration Expense
   - Selling Expense
   - Management Expense
   - Miscellaneous Operating Overhead
2. *Reserve for Repair Accounts*
3. *Special Service Accounts*
   - Locomotives
   - Locomotive Cranes
   - Auto Trucks
   - Teams
   - Tractors
   - Road Rollers, etc., etc.
4. *Shops Overhead Accounts*
   - Various Shops, such as
   - Machine Shop
   - Blacksmith Shop
   - Riggers Shop
   - Welding Shop, etc., etc.
5. *Factory Overhead Accounts*
   - Various Machine and Cost Groups
6. *Foundry Overhead Accounts*
   - By Operations
   - General Overhead
   - Moulding
   - Casting
   - Cleaning and Shipping
7. *Material Handling Accounts*
   - Scrap
   - Pig Iron
   - Limestone, etc., etc.
8. *Service Accounts*
   - Steam
   - Electric Power
   - Light
   - River Pumping Station
   - Hydraulic, etc., etc.
9. *Productive Operations*
   - Coal Mining
   - Blast Furnace
   - Coke Ovens
   - Open Hearth
   - Blooming Mill
   - Bar Mill
   - Sheet Mills
   - Sheet Common Finishing
   - Sheet Special Finishing
   - Warehouses and Shipping

1. General Overhead. For convenience in showing on the cost sheets general overhead accounts are carried under the Manufacturing Account for the month, the first three items being charged to their respective accounts on the General Ledger.

Miscellaneous Operating Overhead is comprised of general overhead departments and items applicable to all works, for ex-

ample, such departments as Works Manager Office, General Superintendent Office, Betterment Department, and other departments of a strictly operating nature. This account is carried into a Suspense Inventory account and charged to all products at the point of shipment.

2. Reserve for Repairs Accounts. The amounts in these accounts are special repairs which are very heavy and fluctuate violently from month to month, having little or nothing in common with the tonnage produced in that month in which the repair occurs. Examples would be "Reserve for Open Hearth Furnace Repairs," "Reserve for Annealing Boxes and Bottoms," "Reserve for Galvanizing Pots," etc.

The actual expense for the month is charged from the cost sheets to the corresponding General Ledger Reserve account and from there rated back to their specific Card of Account items on the cost sheets each month. This rate is established by past practice and is mostly on a production tonnage basis.

3. Special Service Accounts. These accounts are for individual units or groups of units if of the same size, etc. The actual expense on the cost sheet for the month is charged into its corresponding Suspense Inventory account and is rated out from there on the last six months' rate to the various Card of Account items and Work Order cost sheets.

In these cases a service order for such service is made out in three copies, two carbons folding over a tabulating card (similar to the labor service cards explained above), which are used for scheduling the work. When the work is completed they are sent into the Cost Department where they are rated and extended and used as overhead cards. One carbon goes to the Schedule clerk for his permanent file, the other carbon being sent to the Department Superintendent being charged. The tabulating card is punched and used in the same manner as the labor service and material requisition cards.

In the Card of Accounts for these units appear items of delay and idle time hours, such as coal and water hours, repair hours, hours of no work, etc. Cards are made out daily charging each delay item when it occurs. Delay cards are not rated, such delay hours, including that due to no work, not being considered in the actual hours worked, thereby increasing the rate. Idle time hours due to no work are used as a ratio to possible hours for securing that proportion of fixed expense chargeable as idle time cost. This expense is deducted from the total expense to form the amount of expense against the total actual hours operated.

All possible time is accounted for on the cards, whether the unit of equipment is running or not. If the unit ordinarily runs, say ten hours and it works five hours overtime in a day then the possible time for the day is fifteen hours and all this time must be accounted for on the cards.

4. Shops Overhead Accounts. These accounts are for all main-

tenance shops throughout the plant. In this case also the actual expense for the month is charged into its corresponding Suspense Inventory and from there rated out on the last six months' rate to various work order cost sheets. The two carbon and one tabulating card copy are made out in the Cost Department and disposed of in the same way as outlined in the above group of accounts.

At the end of the year, both in the special service and shops overhead Inventory Suspense Accounts the balance whether black or red is written out to the Profit and Loss sheet. But the last six months' rate is still consecutively continued, month by month, in the next year.

5. Factory Overhead Accounts. These accounts are made up of various cost groups and machine units and are handled similar to the special service accounts through the corresponding Inventory Suspense accounts. They are also rated on the last six months' basis but in this case the overhead is carried directly to the product cost sheets, which are on an order basis.

Standard product is covered by an order for each kind of product in suitable quantity to make within a reasonable period. Special orders cover all other product and a cost sheet is made up this way.

Most of these overhead accounts are on a machine hour basis due to the preponderance of machinery, though a few are on a productive labor (operator—not helpers) basis.

6. Foundry Overhead Accounts. These accounts are handled in the same manner as the factory overhead accounts and are on a productive labor hour basis. The product is written into Foundry Inventory and then disposed of in two ways—(a) to the Stores Inventory when the castings are for the plant and (b) to Cost of Sales when the castings are sold.

7. Material Handling Accounts. These accounts are closed out from the cost sheets to the various material accounts affected (principally Raw Stores) in the Stores Inventory. These expenses cover handling on to the piles, etc., but do not cover delivery to the department, the cost of the latter being charged to the department direct.

8. Service Accounts. The power which makes all work possible is the Boiler House in a centralized Power Plant. The steam from the boilers is taken directly to the Power Station where it is used chiefly by the Blooming and Bar Mill engines. The exhaust from these engines, as well as high pressure steam, are used by turbines which are directly connected to large generators, furnishing electric power which drives all the electrical equipment and illuminates the entire plant as well. A switchboard is equipped with switches and meters which keep a record of the amount of power used by each separate unit of the plant. Reports of all power, etc., used are sent to the Cost Department monthly for distribution purposes.

In this case there is a counter-charge, where percentages of the various units are charged against each other. Steam uses electric power and electric power uses steam, and so on through seven or eight of these accounts. These run through a counter-charge sheet, thence through the distribution journal to the various cost sheets.

9. Productive Operations. The costs of productive operations appear in the final operation cost sheets, previous to and including the charge to the various products.

*Coal, Coke and Pig Iron*

Exclusive of sales to customers, coal, coke and pig iron are charged into the various cost sheets through the Stores Inventories at cost plus freight, etc. (after eliminating, of course, the idle time expense in their manufacture).

*Open Hearth Furnaces*

In the Basic Open Hearth process the charge for a furnace consists principally of pig iron, limestone, scrap and other special metals, etc.

The pig iron, scrap and special metals are the metallic charge while the limestone and other various agents are the non-metallic contents for fluxing, etc. The raw materials are hauled from the stock piles to the charging floor by means of a train of charging buggies. Each train load consists of raw materials in proportionate amounts necessary to complete the charging of one furnace.

Furnaces are heated either by natural gas, producer gas or fuel oil, the producer gas being manufactured at the furnaces.

Report of materials used and productions, etc., are shown on heat cards which are sent to the Cost Department. From these cards the necessary compilations are made.

The total expenses of the various processes in this department are charged through the distribution journal to the grades of product (ingots) according to the class of the distribution. The product is in turn charged into the inventories of the corresponding grades and from there liquidated either as cost of sales or by forming the material used by the next department, namely, the Blooming Mill.

*Blooming Mill*

The ingots from the Open Hearth are delivered to this department while very hot. In fact the center of the ingot is in a melted condition. They are put into soaking pits where the heat is evenly diffused and brought down to rolling temperature, when they are rolled through the blooming mill rolls to the size desired and then sheared to proper lengths.

The accounting necessary is the same as for the Open Hearth, the product being billets or slabs for sale or for use in the Bar Mill. Slabs in some cases are used directly in the Jobbing Mills for rolling into plates.

*Bar Mill*

The accounting for the Bar Mill is the same as for the Blooming Mill the product forming sheet bars, either for sale or for the next operations—the Sheet or Jobbing Mills.

After the long sheet bars come off the bar mill proper they are inspected and cut by the Bar Mill shears into proper lengths depending on the width and thickness of the bars.

The length of the bar is the width of the sheet ordered plus the scrap allowance for shearing after rolling on the Hot Mills.

The thickness and width of the bar, or foot-weight, determines the gauge or thickness of the sheet, for when the bars are rolled into sheets the length specified plus the shearing allowance will give the gauge of sheet specified.

The bars are now ready for rolling into sheets.

*Hot Rolling into Sheets*

Before discussing the cost accounting for sheets it might be of interest to briefly describe the various operations in manufacture.

This process is accomplished on sheet and jobbing mills in the Hot Mill Department in the following sequence:

The sheet bars are charged into pair furnaces for heating to a rolling temperature. The pair heating furnace gets its name from the fact that the bars are worked in and out of this furnace in pairs.

When the bars have been heated to the proper temperature they are brought out of the furnace and pulled over to the roughing mill where they are given a number of passes to prepare them for the finishing rolls.

In the majority of cases it is not possible to make finished sheets from the bars as they come from the pair heating furnaces. Therefore to facilitate the handling and increase the tonnage, a regular working scale for different gauges has been devised.

In rolling light gauge sheets the bars are roughed down and the resulting rough sheets matched, and then placed in sheet furnaces and again heated to the proper rolling temperature and given one or two passes through the rolls. After this, they are opened and doubled, that is, each sheet is bent together at one half of its length.

Heavy sheets are finished either singly or in pairs, lighter ones are doubled and finished in packs of four, six or eight sheets to the pack.

After the packs have been rolled to proper length plus the allowances made for uneven edges, they go to the Hot Mill shears for trimming to size. After being trimmed, due to the fact that the sheets have a tendency to stick together during the rolling process, they go to the opener who bends up a corner of the pack, which generally causes the sheets at that point to spring apart sufficiently to allow the insertion of his tongs, when the sheets are separated one at a time.

## Common Finishing Beyond the Hot Mills

*Cold Rolling*

Because of the buckled and wavy condition of sheets as they are delivered from the Hot Mills, one pass on cold rolls is given each sheet to flatten it.

*Annealing*

The rough treatment to which the iron and steel sheets are subjected up to this point has so disarranged the grain structure and molecular construction that the sheets are of but little use for any practical purpose. To overcome this condition and secure softness and ductility it is necessary to resort to annealing, which is a lengthy heat treatment under uniform temperature.

The sheets are stacked on annealing pans (or bottoms) and a large cover is placed over them and carefully sanded around the bottom to exclude air. This is placed in a large annealing furnace, thermostatically controlled by pyrometers, for its long rest under uniform heat temperature.

When this operation is finished we have a common black sheet which is a saleable product.

*Galvanizing*

A large proportion of these common black sheets are, however, galvanized in order to give additional protection against weather and other wearing conditions.

In treating the surface of the sheets for coating or other special finishes, the first operation is a thorough cleansing by the pickling process. The sheets are placed in racks and lifted by a carrier moving in a circle from bath to bath, at the same time being agitated up and down, first through an acid bath then through two washes of water, thus removing all scales, dirt and surface contaminations.

After being pickled the sheets for galvanizing are conveyed in lifts to and stored in tanks containing hydrochloric acid. This acts as a further cleansing agent and is of material assistance in preparing the sheets for coating.

The sheets are then lifted, one by one, from the tank and run through a set of rolls, passing through a flux box, and then through the galvanizing pot proper, which contains molten spelter, the coating material. As the sheets pass through the molten spelter a coating is deposited, but the amount has not been controlled. Therefore, as the sheets pass out of the pot, they go through a set of "exit" rolls, which together with the rate of speed at which the sheets are run through the pot determines the weight of coating.

The coated sheets leave the galvanizing pots on chain conveyors to solidify the spelter coating, thence through roller leveling machines to flatten, on to an inspection table where they are carefully gone over by the Inspector and placed in cooling racks, the defective sheets being offset at the right end of the rack.

If the defect is in the coating these sheets are then sent back to be stripped of its coating, after which it again is treated through the various processes outlined above.

## Special Finish Operations

*Bar Pickling*

In the manufacture of high grade specialty sheets which require a rigid surface inspection, it is necessary to have the surface of the bars clean before rolling them into sheets which is done by means of a bath in sulphuric acid. The acid is then washed off with lime water, after which the bars are ready for the sheet mill furnaces.

In the manufacture of ordinary sheet finishes, such as black and galvanized, the pickling of the bars is not necessary.

*Finish Cold Rolling*

In the majority of cases the requirements of special finish sheets are smoothness and density of surface. To secure this condition they are given a number of passes through finishing cold rolls, the surfaces of which are highly polished.

All sheets for automobile bodies and fenders, metal furniture, cabinet work, locomotive jackets, stoves, etc., undergo this treatment so that a good finish on the enameled or painted surface may be secured.

Finishing Cold Rolls produce a slightly buckled condition and it is therefore necessary to Roller Level them.

*Roller Level*

Roller Leveling machines consist of a series of small rolls, the top set staggered over the bottom set. The weaving motion produced on the sheets automatically levels them sufficient for most purposes.

*Stretcher Level*

Sheets for the manufacture of metal furniture, cabinets, etc., must be dead flat, for the slightest weave or buckle will be greatly augmented in the final finish. Therefore stretcher leveling is resorted to.

This process consists of pulling apart by hydraulic pressure two large jaws, which grip the ends of the sheet.

*Inspection*

A high standard of inspection is maintained, the sheets being minutely examined by experts for surface defects. The defective sheets are thrown out and sold as such.

*Oiling*

The highly polished surfaces of high grade sheets, some of which are almost as smooth as glass, would become scratched and marred in shipping and if subjected to moisture would rust, unless

thoroughly protected. To provide against this oiling machines are used, through which the sheets are run and coated with a thin film of compounded protective oils.

*Resquaring*

For some purposes sheets must be exact to size and square. It is not possible to get them in that condition by shearing the sheets as they come from the Hot Mills, as pack shearing could not be made accurate, and in addition to this fact the material is generally in a buckled condition. Subsequent operations also distort the sheet to a certain extent, therefore resquaring on shears especially built for accuracy is performed. This is generally the last operation before shipment.

## Accounting for Sheet Costs

The control of all sheets through the various operations is by standard finish names and routings, or by special orders where a sheet does not follow a given routing. It does not always follow, however, that these standard routings are adhered to. There are conditions of extra operations, operations sometimes omitted, retreatment in various operations and in some instances diverting the sheets from one finish to another during the processes. All of these except the latter condition are necessary to bring the sheet to the desired condition to meet neecssary requiremnts of a particular finish or a customer's special requirements.

The roller on the Hot Mills receives a copy of the Hot Mill schedule card, which shows the gauge, size, finish, etc., of the sheets to be rolled. The first copy of this schedule card has already been forwarded to the Bar Mill to serve as an order for the bars required.

As the items shown on this order are rolled the roller enters the necessary information to the Pair Slip, which is made up in triplicate. This Pair Slip is a production sheet of each turn of each hot mill, either sheet or plate.

All copies of the Pair Slips are then sent to the shearman, who records thereon the number of good sheets, cutdowns, cutups, etc. He then forwards the copies to the sheet mill weighmaster.

The control of sheets through all operations beyond the Hot Mill is by lifts. A lift of sheets is a quantity easily picked up by a crane and varies from a few thousand to ten or twelve thousand pounds, in some instances more.

As the material is weighed off the Hot Mill shears, the weighmaster enters the weight by lifts and he assigns the lift number to the Pair Slips and makes out a lift schedule in triplicate.

The original and duplicate are forwarded to the Schedule Office where additional copies are made out for each operation thereafter. The triplicate, which is a hard card, accompanies the lift through all operations.

Of the three copies of the Pair Slips the original is sent to the Timekeeping Department, where it is used for making up the Tonnage Payroll. The duplicate is retained in the Schedule Office where it is used as a posting medium for progress records. The triplicate is sent to the Operating Chief Clerk (who takes certain information therefrom) and then to the cost department. The cost department uses this record as a basis for all Hot Mill production reports as follows:

When the Pair Slips are received by the cost department two tabulating cards are punched. One is a *monthly* production card, which shows only the month's production, and the other, a "Check File Card," is a continuous record of all operations from and including the Hot Mills irrespective of the month in which performed.

These two cards are used for all operations and the operation numbers and change of weights as they occur are identically punched on both cards. As the schedules come in for succeeding operations on each lift these cards are pulled from their files and the operation number and new production weight (if any) is punched thereon.

In cases of retreatment separate cards are punched and where the retreatment is more than one pass in the same operation the weight is multiplied by the number of passes.

The monthly production cards are kept in a current file. Hot Mill weekly production reports by "Finish" for the Operating Department are prepared from them each week.

At the end of the month regular monthly production reports for each operation are drawn off by Finish and Gauge and totaled as to each operation. At the same time the number of square feet and of distribution factors applicable to each gauge of each finish are put against the corresponding item and totaled.

The total production for each operation and its average gauge is then entered on the operating cost sheet for that operation and the total quantity of each distribution factor for each operation is entered on its corresponding Process Inventory, awaiting the total value of that distribution factor from the operating cost sheet, which as soon as taken from the expense tabulating cards is entered against the above quantity in the Process Inventory.

These Process Inventories, as soon as the available is determined, are then ready for pricing of Finished Stock Cost cards.

## Finished Stock Cost Cards

The Check File cards mentioned above are kept in a Process Check File until the last operation has been performed on the lift, when they are filed in what is called a "Stock Finished in Current Month" file.

From these cards the monthly Finished Stock Cost cards are made up. At the end of the month all the Check File cards are

sorted by Finish, Grade and Gauge, and subsorted by operation number and a set of cards for a given gauge of a given grade and finish are run through the tabulator and entered on Finished Stock Cost cards, one for *each* operation.

This card is a tabulating one but the only punched information thereon is the "sorting" information. The tabulating information cannot be punched owing to the fact that it is too voluminous for the capacity of the card.

The cards are numbered consecutively, as the information is taken off the tabulator from the Check File cards, starting with number one for the first operation of the first finish and the last number ending up with the last operation of the last finish.

As rapidly as each set of these cost cards are made up from the tabulator they are turned over to a clerk who proves the written entries to the tabulator total and then figures the scrap, adjustments, if any, seconds on Inspection operations, etc. They are then passed on to another clerk who rates for quantity of distribution factors where required and extends such quantities. The cards are now ready for pricing from the Process Inventories and this is done through a price sheet which has been previously drawn off from these inventories. When priced the cards of each set are extended and an adding slip made of the total expense on each card and at the same time a grand total of all expense for the set, this latter being then entered, together with the final production weight of prime sheets which appears on the last card of the set, into a Report of Finished Stock costs which is as follows:

| | (Finish) | | | (Finish) | | |
|---|---|---|---|---|---|---|
| Gauge (in numerical sequence) | Qty. | Per 1000# | Amount | Qty. | Per 1000# | Amount | etc., etc. |

This report is then typed and sent to the General Manager and Works Manager.

The pencil copy is then used to charge the production into the Finished Stock Inventories which are kept by each gauge of each finish and grade.

The Finished Stock Cost cards are then sorted by Operation number and each operation has its distribution factor quantities and corresponding values which are totaled on an adding machine. These totals are entered on a "Summary of Credits to Process Inventories," which is used to relieve each Process Inventory in one amount for the month. It is also matched against the Report of Finished Stock Costs, with which it must agree, thereby proving that all the additions were correctly made.

The cards are then sorted back to Card Number, which puts them in the order that their totals appear on the Report of Finished Stock Costs. Thus they are ready for instant reference if needed.

If any costs appear out of line on the Report of Finished Stock Costs then the corresponding cost cards are consulted and in very short order a detailed cost sheet showing the bars used and the essential information of each consecutive operation thereon is made up and presented to show the reason for the discrepancy.

This practice carries out the principle of exceptions when a mass of cost sheets are *not* made up to remain, in most cases, undigested by those executives who should have a comprehensive report of costs in brief form. This is obtained in the Report of Finished Stock Costs outlined above which shows the gauges vertically and the finishes horizontally.

All costs of a given finish are made up to include the last regular operation. If additional operations are given beyond this for which the customer pays an extra, such as Resquaring, Stretcher Leveling, etc., then material is drawn from Finished Stock Inventory at the last regular operation and the above procedure is followed to produce a cost with these extra operations added.

Cost of Sales is drawn from the Finished Stock Inventory by each gauge of each finish and grade, to which is added Warehouse and Shipping cost, etc., to form the total manufacturing Cost of Sales.

## Special Features

There are in the different phases of iron and steel manufacture above probably every known kind of cost system and a great many special conditions which cannot be covered in a short article. Even in the factory on some few special orders the condition of joint costs obtains. A few of these special features follow:

### 1. Scrap Produced

Scrap is produced in quite a few operations—Blast Furnaces, Open Hearth, Blooming Mill, Sheet Mills, Reshearing, Resquaring, etc. Production of scrap is added to the prime cost of the material by allowing credit at current market price (at the time of such production) for the class of scrap produced. Practically all this scrap is returned to the Blast Furnaces or Open Hearth to be remelted.

Mill equipment scrap, is, of course, credited to operating cost as the replacement is charged as an expense. In some cases construction work receives the credit.

### 2. Seconds

From the Inspection operation, second sheets, not good enough for the customer's requirements or defective are thrown out and sold as seconds. As in the scrap produced, the loss occasioned in not producing good prime sheets is charged against the prime stock by giving them credit for the seconds at market value.

### 3. Spelter Dross

In the galvanizing of sheets spelter is used and a dross is produced in the pots. There is a recovery of approximately 80% spelter in this dross. The galvanizing coating operation is given credit for this amount when the pots are cleaned.

Spelter is controlled through tests which are made every hour on the sheets going through the pots. These tests submitted to the cost department monthly form the basis of the distribution of the spelter to the sheets, the total spelter used being measured as follows: height of spelter in the pot at beginning of month, plus spelter added during the month, less height of spelter in the pot at the end of month, equals spelter used during the month. Necessarily the height of spelter in the pot is converted to weight of spelter in this formula.

### 4. Idle Time Expense

From each department idle time expense is collected on one cost sheet in departmental number order to form a summarized statement. Copies of this information are sent to the General Manager and the Works Manager. From this summarized cost sheet the expense is charged directly into Profit and Loss monthly.